

## MICRO-NUTRIENT ACTIVITY OF SUNDARI (*Heritiera fomes*), THE MANGROVE PLANT

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### ABSTRACT

The name *Sundarban* can be literally translated as "beautiful forest" in Bengali language (*Shundor*, "beautiful" and *bon*, "forest"). The name might have been derived from the Sundari trees (the mangrove species *Heritiera fomes*) that are found in Sundarban in large numbers. Sundarban the mangal vegetation comprises of 94 intertidal sp. but less than 10 sp. are utilized by the locals as food & fodder materials. The sp. like *Avicennia alba*, *A. marina*, *A. officinalis*, *Sonaratia apatala*, *S. casiolearis*, *Heritiera fomes*, *Nypa fruticans* are consumed either as vegetables or beverages. Fruits of *Heritiera fomes* are popular for making pickles & nuts and it became more popular during stress times in Sundarban. Micronutrient activity of *Heritiera fomes* has been under taken in order to determine the suitability for human use as food material.

**KEYWORDS:** Edible Mangrove Fruits, Indian Sundarban, Micronutrient Activity

### INTRODUCTION

The Sundarban (Bengali: *Shundorbon*) is the largest single block of tidal halophytic mangrove forest in the world. The Sundarban is a UNESCO World Heritage Site covering parts of Bangladesh and the Indian state of West Bengal. Two-third of the Sundarban is in Bangladesh and the remaining third in West Bengal, India. The name *Sundarban* can be literally translated as "beautiful forest" in the Bengali language (*Shundor*, "beautiful" and *bon*, "forest"). Alternatively, it has been proposed that the name is a corruption of *Samudraban Shomudrobon* "Sea Forest" or *Chandra-bandhe* (name of a primitive tribe). However, the generally accepted view is the one associated with Sundari trees. (Pasha et.al., 2003). 43 mangroves (Sanyal.P, 2009) have local medicinal use, but less than 10% fruits are edible. The mangals showing both morphological as well as physiological adaptability are considered as 'True Mangroves'. Sundari (*Heritiera fomes*) is considered as a 'True Mangrove'. Knowing the valuable effect of this mangrove, the main aim and objectives of the present project is to estimate the micro-nutrient content and presence of phyto-nutrients of this mangroves fruit.



Figure 1: Sundari Leaves and Fruits

## PLANT DESCRIPTION

**Scientific Classification** (Wiktor Kotowski et.al.2007).

**Kingdom:** Plantae

**Order:** Malvales

**Family:** Sterculiaceae

**Genus:** *Heritiera*

**Species:** *H. Fomes*

**Scientific Name:** *Heritiera fomes*

**Local Name:** Sundari

### Climate Condition

Sundarban, the mangrove forests of the coastal districts North and South 24 Parganas. In case of Climatic condition, the average minimum and maximum temperature is 20 °C and 48 °C respectively. Rainfall is heavy with humidity as high as 80% as it is close to the Bay of Bengal. The species (*Heritiera fomes*) is distributed up to about 20 per cent of the forest.

### Tree

Trees up to 20 m tall, trunk about 50 cm in diameter at base, prominently buttressed; blaze dark-red; young branches covered with shining golden-brown scales.

### Leaves

Leaves 5-12 x 3-6 cm, elliptic, upper surface green, lower surface shining with silvery scales, tapering at both ends.

### Root

Roots with pneumatophores and blind root sucker.

### Flower

Flowers in auxiliary panicles, unisexual, densely pubescent, and golden-yellow with reddish tinge inside; calyx 5 or rarely 4-6 toothed; petals absent; male flowers: stamen united into a column and anthers lobes forming a ring at the top; female flowers: carpels 5-6, nearly free.

### Fruits

Fruit (ripe carpels) 3-4 cm across, sub-globose, corrugated, woody, indehiscent, furrowed on the inside and less prominently winged on the outer side. Fruiting during May-August. (Kathiresan K et.al., 2005)

## MATERIALS AND METHODS

### Procurement of Plant Materials

The fruits of *Heritiera fomes* were collected from Jharkhali area in Sundarban, West Bengal (India). Authentication was confirmed by BOTANICAL SURVEY OF INDIA (BSI), West Bengal, and (India).

- To estimate the micro nutrient content of this mangrove fruit e.g. Iron, Calcium, sodium, potassium, copper, zinc, manganese, magnesium content following method issued: Determination of micro nutrients by ICP-OES(2012)
- **Preparation of Ethanolic Extract**

Soxhlet extraction, the oldest and conventional method of extraction of bioactive substances from natural sources was employed for extract preparation. (Kumoro A.C.et.al.,2009). 15 gm of air dried tuber powders were placed in the Soxhlet thimble and extracted with 200ml of respective solvents continuously for 30-40 hours. The solution thus extracted was filtered through muslin layer, centrifuged and the collected filtrate was evaporated to dryness on hot plate at constant temperature of 60°C. The clumpy dry residue obtained was scraped by knife, made into fine powder form and stored in air tight plastic vials.

### GC-MS Analysis: Preparation of Extract

The dried ethanolic extract of *Heritiera fomes* was dissolved in absolute ethanol (1mg/ml). 10ml of this sample was then injected for gas chromatography- mass spectrometric (GC-MS) analysis. (Merlin NJ et.al., 2009)

### Instruments and Chromatographic Conditions

GC-MS technique was used to identify the phyto-constituents present in the extract (Merlin NJ et.al., 2009). The plant extract was analyzed using Agilent Technologies 6890 N Network GC system & interfaced to Agilent Technologies 5973 Inert Mass Selective Detector employing the following conditions: column DB-1 ms fused silica capillary column (30X0.25 I.D.X 0.10 Film, composed of 100%Dimethylpolysiloxane) chosen for improved signal to noise ratio for better sensitivity and mass spectral integrity, operating in electron impact mode; helium (5.0) was used as carrier gas at a constant flow of 1ml/min. The injector, MS Source & MS Quadra pole temperature were fixed at 250°C, 230°C & 150°C respectively and turbo Speed of the pump was 100%.

The oven temperature was programmed from 50°C (isothermal for 5 minutes), with an increase of 10°C/min to 100°C (isothermal for 2 minutes), then 10°C/min to 300°C (isothermal for 5 minutes) for tuning of the MSD in EI mode Perfluoro tributylamine (PFTBA) was used as tuning compound. Mass spectra were taken at 2235 EM Volts and fragments from 69 to 502.

### Identification of Components

Interpretation on mass spectrum of GC-MS was done using the database of National Institute Standard and Technology (NIST)/National Bureau of Standard (NBS) and Wiley having more than 62,000 patterns. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST/NBS and Wiley libraries. The name, molecular weight and structure of the components of the test materials were ascertained.

## RESULTS AND DISCUSSIONS

*Heritiera fomes* fruit contain various micro-nutrients. So at a glance it reveals that this fruit is beneficial for those who are suffering from kidney disease, syndrome of edema etc. These apart in humans, sodium is an essential nutrient that reduce blood pressure and the sodium concentration in the kidney result in the production of rennin, which in turn produces aldosterone and angiotensin, retaining sodium in the urine. Because of the increase in sodium concentration, the production of renin decreases, and the sodium concentration returns to normal. (McGuire et.al., 2011).

Sodium is also important in neuron function and osmo-regulation between cells and the extracellular fluid, their distribution mediated in all animals by  $\text{Na}^+/\text{K}^+$ -ATPase. (Campbell et.al., 1987). Hence, sodium is the most prominent cation in extracellular fluid. Potassium is the major electrolytes inside cells (intracellular) the Osmotic effect holds water inside cells & counter Balance the osmotic effect of Sodium (Na). It helps conversion of Blood glucose  $\rightarrow$  stored glycogen, Synthesis of muscle protein & energy production. Potassium ions also play a role in nerve impulse transmission to stimulate muscle action. Equal amount of Na & K help to prevent the development of hypertension, this diet is called DASH [Dietary approaches to stop Hypertension]. (L. Kothleen Mahan et.al., 2008)

**Table 1: Micro Nutrient Content in Each 100gms of Fruit**

Name of the Fruit	Calcium (mg)	Iron (mg)	Sodium (mg)	Potassium (mg)	Zinc (mg)	Copper (mg)
<i>Heritiera fomes</i>	0.93	0.16	0.54	13.10	0.15	11.91

**Table 2: Micro Nutrient Content in Each 100gms of Fruit**

Name of the Fruit	Magnesium (mg)	Manganese (mg)	Chromium (mg)	Cobalt (mg)	Boron (mg)
<i>Heritiera fomes</i>	1789.19	6.54	0.035	0.0696	41.42

The fruit contain below 1mg/100gm of zinc. Zn plays important structural role as a component of several proteins and function as an intra- cellular signal in brain cells. Metallothionein is the most abundant, non-enzymatic zinc containing protein which has low-molecular weight & rich in cysteine. Zn is abundant in the nucleus where it stabilized RNA & DNA structure and for the activity of RNA polymerase. Zn also acts in chromatin protein involves in transcription & replication. (L. Kothleen Mahan et.al., 2008). Cupper (Cu) content is quite good for sundari. Cu has frequently been called the “IRON TWIN” because both Cu & Fe are metabolized in much the same way & both are components of cell enzyme. Cu protein complex known as ceruloplasmin plays an important role in the transport of Fe in transferrin for hemoglobin synthesis. Cu plays a part in preventing anemia by stimulating the Synthesis of the haem or globin functions of the haemoglobin molecules .Cu is the part of the enzyme tyrosinase which helps to convert tyrosin  $\rightarrow$  melanin (Subhangini A Joshi, 2010)

This fruit contain high amount of magnesium (Mg) which plays as catalyst in many metabolic reactions. Mg is required to activate the enzyme in the oxidative phosphorylation of ADP to ATP & also for the return of ATP to cyclic AMP which in turn regulate parath-hormone secretion (Helen A Guthric, 1983). Mg involves in conduction of nerve impulse that stimulate muscle contraction and also help to prevent Cardiovascular disease by maintain normal heart beat & blood pressure (Staci Nix, 2009). The Manganese content is also appreciable. Manganese is an essential trace nutrient in all

forms of life. The classes of enzymes that have manganese cofactors are very broad and include oxidoreductases, transferases, hydrolases, lyases, isomerases, ligases, lectins, and integrins.

The reverse transcriptases of many retroviruses (Though not lentiviruses such as HIV) contain manganese. The best-known manganese-containing polypeptides may be arginase, the diphtheria toxin, and Mn-containing superoxide dismutase[Mn-SOD] (Larsson SC et.al.,2008). Boron content is good in per 100gm of the fruit. Boron has several important functions in our body. Its deficiency alters brain function and reduces bone composition, structure & strength.

Boron is also thought to compete with some enzyme for the co-enzyme NAD. Though cobalt content is below 1 mg in this fruit but the well known essential role of cobalt is a component of Vit-B12 (Cobalamin). This Vitamin is essential for the maturation of red blood Cells & the normal function of all cells. Methionine amino peptidase, an enzyme involved in the regulation of translation (i.e. of DNA to RNA) and it is the only enzyme in humans known to have an established requirement of this trace element. (L. Kothleen Mahan et.al, 2008).

- **Results of GC-MS Analysis:** Gas chromatography was used to know the other components which are presents in this fruit and few of them should be beneficial for human.

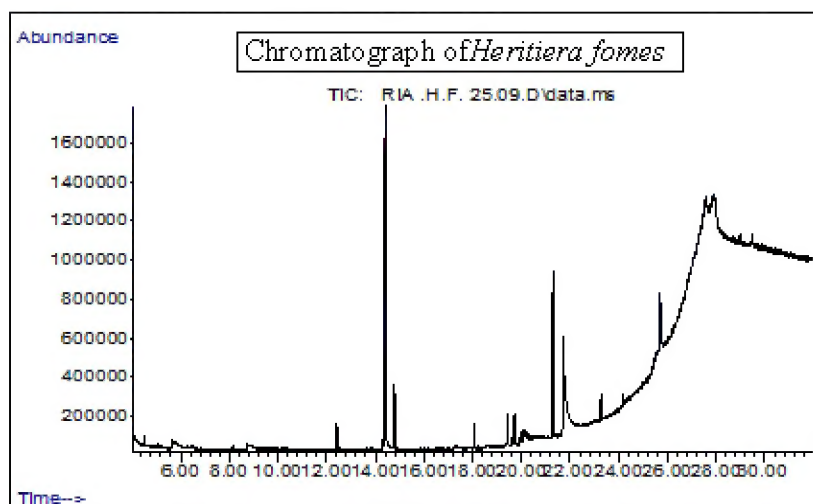


Figure 2

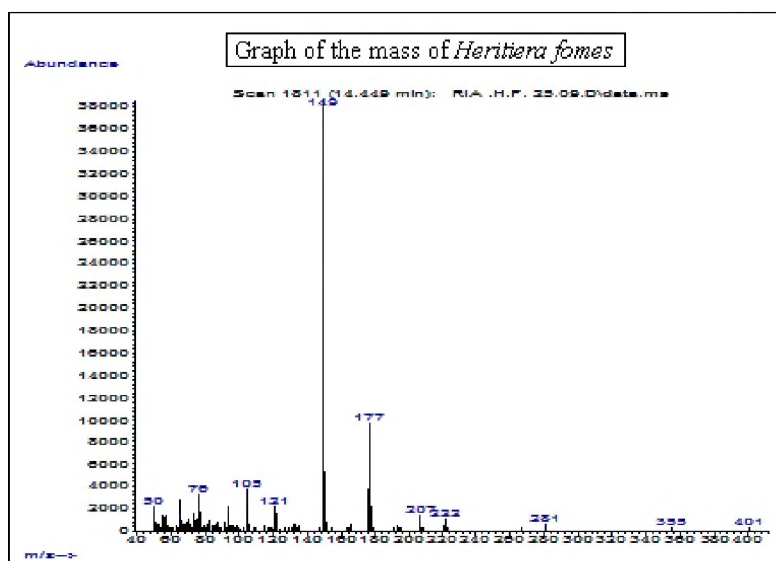


Figure 3

Table 3: From this above Chromatogram these Peaks Identified the following Phyto-Constituents: (Jim Duke, 1998)

SL. NO	Retention Time	% Peak Area	Compound	Pharmacological Activity
1	12.41	0.95	10-Undecenoic acid, methyl ester	Used as artificial flavors.
2	14.78	1.46	Hexadecane	Not Reported
3	14.403	10.65	Dibutyl Phthalate	Antimicrobial Antifouling
4	18.09	0.65	Hexadecanoic acid, methyl ester	Antioxidant, hypocholesterolemic nematocide, anti-androgenic flavor
5	21.73	12.90	Undecylenic Acid	use for fungal skin infections, relieves itching, burning, and irritation
6	20.160	2.60	9,12-Octadecadienoic acid (Z,Z)-, methyl ester	Anti inflammatory, hypocholesterolemic cancer preventive, hepatoprotective, anti histaminic antieczemic, antiacne, 5-Alpha reductase inhibitor, anti androgenic, anti arthritic, anti coronary, insectifuge

## CONCLUSIONS

**Sundari** (*Heritiera fomes*), is one of the micro nutrient rich mangrove fruit available in most of coastal mangrove forest in India. It contain Mg, Mn, Cu, K, Br and little amount of Fe, Ca, Zn, Cr is found in this fruit which can be the substitute source of nutrient for the people live at coastal part of India like fisherman and other below poverty level because they are unable to buy costly nutrient rich food and product from market, but this fruit is available and cheapest source of micro-nutrient for this people if it included in our daily food habit. Therapeutic mechanism of a plant can be better understood with a proper investigation of its active reagents. The compounds identified by the GC-MS analysis of ethonolic extract of *Heritiera fomes* fruit relates their applications in folklore medicine and these active components may lead to low cost drug development against oxidative stress as well as other killer disease. It can turn out to be a promising nutraceutical in future.

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